

States, 87.0; West Gulf States, 83.5; Lower Lake Region, 87.0; Upper Lake Region, 88.1; Tennessee and the Ohio Valley, 86.3; Upper Mississippi Valley, 85.6; Lower Missouri Valley, 84.6. Of the 3,698 predictions that have been made, 122 or 3.3 per cent. are considered to have entirely failed; 177 or 4.8 per cent. were one-fourth verified; 356 or 9.6 per cent. were one-half verified; 303 or 8.2 per cent. were three-fourths verified; 2,741 or 74.1 per cent. were fully verified, so far as can be judged from the tri-daily weather maps.

Cautionary Signals.—167 Cautionary Signals were displayed, of which 140, or 83.8 per cent. were justified. 132 Cautionary Off-shore Signals were displayed, and of these 127 or 96.2 per cent. were justified as to direction; 118 or 89.4 per cent. were justified as to velocity. Of the Cautionary Off-shore Signals, 63 were changed from Cautionary. 299 signals of both kinds were displayed, of which 250 or 83.6 per cent. were fully justified. The above does not include signals ordered at 45 display stations where the velocity is only estimated and not measured. 110 cases were reported of winds of 25 miles or over where signals were not ordered; in only eight of these cases did the velocity reach 40 miles.

NAVIGATION.

In the table, on right side of chart No. III, are given the highest and lowest readings, on the Signal Service river-gauges, during the month, with dates of same. On the 15th the *Tennessee*, at Chattanooga, was five feet above the danger-line, and on the 19th and 29th, respectively, the *Cumberland*, at Nashville, and the *Ohio*, at Pittsburg, rose within a few inches of the danger-line.

Ice on Rivers and Lakes.—*Missouri*—Leavenworth, 31st, river frozen over during entire month, ice about 20 inches thick, heavily loaded teams crossed daily. *Mississippi*—Minneapolis, Minn., 31st, ice in river 26 inches thick. La Crosse, 31st, river frozen over during month. Dubuque, 29th, ice in river weak and porous from recent high temperatures and travel across entirely ceased. Keokuk, 31st, wagons and foot passengers crossed the river on ice during nearly the entire month. St. Louis, 1st, river frozen solid above the bridge but clear in harbor to the south of it; 2d, river frozen, thin ice running in harbor; 3d, 4th, river frozen; 5th, river closed in harbor excepting a narrow channel one-fourth of a mile wide, south of bridge, ferries stopped running; 6th to 24th, river frozen; 25th, ice decaying; 26th, ferries and tug-boats broke up gorge in river, river clear from the bridge south to Carondelet; 27th, river remained the same south of the bridge, ferries and tug-boats breaking gorge north of bridge, ice quite rotten; 28th, gorge north of bridge partially broken up, very little ice running in river, heavy ice loosened from above in the evening; 29th, slush ice running in river, but clear north of bridge; 30th very little slush ice in river; 31st, heavy floating ice in river, steamer arrived in the afternoon from Cairo, navigation resumed. Cairo, river remained frozen to the 26th, breaking up in the evening; 30th, entirely clear of ice; navigation closed from December 28th, 1878, to January 30th, 1879. Memphis, 1st to 4th, 10th, 12th to 16th, floating ice in river; 14th, 16th to 27th, drift wood in river. Pt. Pleasant, La., 6th to 15th, floating ice in river. *Verdigris River*—Independence, Ia., 27th, ice broke up; 28th, river very high. *Arkansas*—Fort Gibson, 2d, river frozen over; 23d, ice all passed out of river; 27th, river rising rapidly and filled with floating ice and drift-wood. *Ohio*—Pittsburg, 3d, river frozen over; 24th, ice-gorge in river; 27th, ice-gorge broken up, navigation open. Wellsburg, W. Va., 2d, river frozen over; 19th, ice started at 6:50 p. m., moved down about 100 feet and stopped, started again at 7:50 p. m., and run until about 11 p. m. 20th, ice started about 8 a. m. Cincinnati, 1st, floating ice in river, two boats left for Pomeroy, no arrivals; 2d, new ice covered the river, ice gorged for a short time, boats laid up, two arrivals, one from Kentucky river and one from Pomeroy; 3d, crossing river on ice five miles above station, ice gorged at many places between Aurora and Maysville; river closed in front of city at night; 4th, skating on river, ice gorged above and below city; 6th, skating and crossing on ice; 10th, ice in river still intact, rapid rise in the Kanawha, Guyan and Big Sandy rivers, and destruction of considerable floating property; many tug-boats employed in breaking up the ice in river near city; 11th, tug-boats breaking up the ice, pedestrians crossing on the ice; 12th, people crossing on ice, up to a late hour ice remained intact; 13th, river rising rapidly, ice broke at 4 p. m., ice running heavily and several gorges forming, very little damage done; 14th, heavy ice passing all day; 15th, heavy ice running until noon, navigation resumed; 16th, river rising, heavy ice passing; 17th, river falling, heavy ice passing; 18th, river rising, heavy shore-ice passing all day, ice in the Licking river began running out; 19th, river rising, very little ice passing, boats arriving report navigation very difficult and damaging the wheels, Licking river still running out, ice well broken up; 20th, river rising, heavy ice passing in the channel, in some instances twenty feet thick; 21st, river rising, very little ice passed, but in very large "bergs"; 22d, river falling, very large "bergs" running in morning, but very little ice in afternoon; 24th, river rising, very heavy ice passed on Ohio side in morning, navigation resumed from Parkersburg to New Orleans; 25th, river rising, floating ice in river; 26th, river rising, heavy ice passing in morning but disappearing in afternoon; 27th, river rising, scarcely any-ice visible; 28th, river rising heavy ice passing all day; 29th, heavy ice passing all day thinning out some in the evening; 31st, river rising, no ice passed to-day. Cairo, 1st to 14th, heavy floating ice in river extending from shore to shore; 15th, 18th, about clear of ice; 13th, ice gorged in river above Paducah; 18th, Paducah, ice-gorge broke this morning; 20th, 21st, drift-wood in river; 22d, ten wrecks (barges and flat-boats) passed station during the day, caused by heavy floating ice; 19th to 22d, heavy floating ice in river; 23d to 25th, ice extending from Illinois shore to middle of river only; 26th to 31st, entirely clear of ice; navigation closed from December 25th, 1878, to January 26th, 1879; damage caused to shipping by heavy floating ice estimated at \$65,000. Louisville, 2nd, freezing along shore; 3d, river frozen over above station; 6th, river frozen over except in current; 14th, ice in river breaking up; 15th, ice-gorge passed station, carrying away several canal barges and driving a steamboat ashore; 22d, small quantities of floating ice in river;

2nd to 19th, Portland and Louisville canal frozen over; 20th, canal open; 22d, navigation resumed to-day. *Alleghany*—Tarentum, Pa., ice broke up; Pittsburgh, 3d, river frozen over; 18th, river open for several miles above city; 19th, ice gorge broke about noon, sinking a number of canal boats and barges; 20th, 21st, 22d, river full of floating ice; 24th, little ice in river; 25th, river clear of ice; 28th, ice running all day; 29th river full of floating ice; 30th, heavy ice moving all day; 31st, ice nearly all out. *Monongahela*—Morgantown, 17th, ice gorged in river, carrying away portion of river gauge, water rose twelve feet in 30 minutes; 21st, heavy ice in river; 22d, river clear of ice; 23d, floating ice in river. Pittsburgh, 3d, river frozen over. *Buffalo Creek*—Wellsburg, West Va., 18th, ice run out, thawing rapidly. *Scioto River*—Columbus, 28th, ice broke up. *Tennessee River*—Chattanooga, 9th, two steamers sunk between Kingston and London by floating ice; 10th, river rising rapidly, gorge giving way above; 13th, river reached danger line; 14th, river rising rapidly and overflowing lower portions of city; 15th, river reached highest point, 38 feet above zero of gauge; 16th, river falling. *Roanoke River*—Weldon, N. C., 3d, 4th, full of floating ice; 5th, frozen over solid, which had not occurred before since 1857; 6th, river seems to have stopped flowing, no water in view, ice seems to be lying on the bed of the river; 7th, one or two small streams commenced to flow on top of the ice; 8th, ice broke up and began moving in immense quantities; 12th, river high and rising, channel clear, ice heaped near the shore; 13th, river overflowing banks and rising all day; 14th, still rising, about three inches during the day and twelve during the night; 15th, rose five inches during day. *Red Is and Creek*—Wytheville, Va., 12th, ice gorged, water overflowed the low ground, carrying away six cattle; in a short time gorge burst and tore out part of mill dam, carried off considerable material and excavated huge rocks, damage estimated at \$500; 11th, ice moved out of Barrett's dam during the night; 12th, water very high. *Rivanna River*—Broad Oak, Va., 22d, river clear of ice. *James River*—Dover Mines, Va., 14th, river clear of ice; 16th, canal open to navigation, having been closed by ice for twenty-one days. *Potomac River*—Ft. Whipple, Va., 1st, ice in river firm; 2d, river still frozen; off Ft. Foote, 3d, ice 12 in. thick. Georgetown, continued frozen during the month. *Patapsco*—Woodstock, Md., 9th, river open. Baltimore, 3d, harbor and basin covered with solid ice, navigation almost entirely suspended; 4th, several tug boats fast in the ice near Annapolis; schooner "Eastern Light" sunk off Hell Point, with 300 bushels of oysters, and schooner "Burning Hall" sunk near Highlands, the crews of both being compelled to make their escape on the floating ice; several oyster schooners fast in the ice and abandoned by the crews; 5th, fourteen tug boats and several oyster schooners ashore down the river. *Susquehanna*—Catawissa, Pa., north branch closed during month. *Hudson*—West Point, N. Y., 3rd, river completely frozen over; New York, 3rd, floating ice in river, causing many interruptions to travel; Sandy Hook, 3rd, bay full of floating ice. *Flushing Bay*—Flushing, N. Y., 31st, navigation still closed. *Narraganset Bay*—Newport, 3rd, ice forming in harbor. *Buzzards Bay*—New Bedford, Mass., 6th, harbor covered with ice; 28th, ice breaking up. *Vineyard Sound*—Wood's Holl, 3rd to 12th, ice in harbor; 13th, 25th, ice gorge in harbor. *Otta Queche River*—Woodstock, Vt., ice on river 19 inches thick. *Lake Superior*—Duluth, 14th, ice forming rapidly on surface of lake; 15th, lake frozen; 26th, ice breaking up, harbor full of floating ice. *Lake Geneva*—Bloomfield, Wis., 6th, ice sixteen inches thick. *Lake Michigan*—Grand Haven, 7th, miles of ice on lake outside of pier; 15th, in many places at the distance of half a mile from shore ice 30 to 35 feet deep, extending to the bottom of the lake; 16th, outlet made for the ice-bound vessels, through the force of the high east winds starting the ice. *Embarrass River*—Embarrass, Wis., 29th, ice on river 24 inches thick. *Grand River*—Grand Haven, 7th, river frozen over to a considerable distance from its mouth, ice extends nearly to the bottom; 15th, workmen trying to cut a channel at the mouth of river to liberate the ice-bound vessels. *Grand Traverse Bay*—Northport, Mich., 31st, no ice in bay. *Lake Erie*—Sandusky, 6th, teams came over ice from North Bass Island, distance twenty-four miles; ice in middle of lake reported 14 inches thick. Cleveland, 3rd, lake covered with ice as far as the eye could reach, 6th, lake still frozen; 7th, ice in lake broken; 21st, heavy ice on lake; 27th, ice solid; 29th, ice breaking up; 30th, ice driven ashore. *Cuyahoga River*—Cleveland, 21st, ice in river, 33 inches thick; 27th, ice breaking up. *Lake Champlain*—West Charlotte, Vt., 30th, lake mostly frozen over; 31st, floating ice in lake. Burlington, 10th, navigation closed; 29th, lake entirely frozen over; the records at this place show that the average date of closing, for the last sixty years, has been on January 29th.

Low Tides.—Indianola, Tex., 1st to 21st; Tybee Island, Ga., 12th; Baltimore, 4th and 5th, lowest tide on record.

TEMPERATURE OF WATER.

The temperatures of water, as observed in rivers and harbors, with average depth when observations were taken, are given in table on chart No. II. At Alpena, Buffalo, Cleveland, Escanaba, Grand Haven and Sandusky no observations were made on account of ice. At the following stations observations were only made on the dates named: at Burlington, from the 1st to 12th; Chicago, 24th to 31st; Detroit, 29th to 31st; Duluth, 1st to 14th and 27th to 31st; and at Marquette, 26th to 31st. Punta Rassa, Fla., (too late for table on chart,) max. 70°, min. 54°, average depth, 12 feet.

ATMOSPHERIC ELECTRICITY.

Thunder-storms.—Louisville, Ill., 28th; St. Meinrad, Ind., 28th; Bowling Green, Ky., 28th; Lebanon, Mo., 28th, Tarentum, Pa., 27th; McMinnville, Tenn., 28th; Thomasville, Ga., 12th; Pt. Pleasant, La., 11th, 27th; Okalooska, La., 7th; Franklin, N. C., 28th; Clarkesville, Tex., 27th; San Antonio, Corsicana and Castroville, Tex., 26th; Shreveport, La., 11th; St. Louis, 28th.